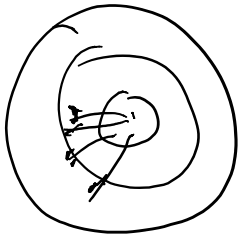
Accuracy and Precision

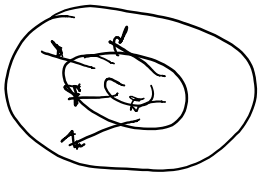
Look at shooting arrows at a target.

1. arrows grouped on bullseye - accurate and precise



2. arrows grouped but off-precise not accurate

3. arrows spread but centred- accurate not precise



Definitions:

Accuracy - How close the measurement is to the "true" or accepted value.

triangulation - measure something in different ways

systematic deviation - where the data gets shifted by an unintended factor.

When doing labs, quantify the deviation from the theory or accepted value,

sometimes, given as a percent deviation
%deviation = |experimental-theoretical|/theoretical x 100%
compare it to the precision of the experiment

precision: The amount of uncertainty in measurements is related to the precision. If you repeat the measurement, what is the range of the values?
eg. 15.9 cm, 15.5 cm, 15.9 cm
range is 0.4 cm, so an estimate of the uncertainty is +/- 0.2 cm
determine the uncertainty 2 times

1. estimate from the equipment - smallest unit on the device - and your use of the equipment - stopwatch is limited by your reacting time
2. look at the range of data/2

pick the larger one

uncertainty rules:
add or subtract - add the absolute uncertainty
multiply or divide-add the percent uncertainty

used mainly in labs -
for most problems, uncertainty is done by keeping track of the significant digits - quick and imprecise

way of dealing with precision.

sig fig rules:
all non-zeros are significant
zeros after the decimal point and after a sig fig, are significant
zeros in the middle are significant
zeros for place value are generally not significant
eg give the number of sig figs in the following:
a) 28736 b) 3.030 c) 0.0000234 d) 2.0×10^9
b) 5 b) 4 c) 3 d) 2

mulitply/divide - round to the least number of sig figs
add/subtract - round answer to the least precise decimal place of the original values (same units and power)

Lab -
Not formal - no report
measure the density of one block of either copper (8.96 g/cm^3) iron (7.87 g/cm^3) aluminum (2.70g/cm^3)
using
3 different electronic balances and determine the average mass and the uncertainty using the range

2 different students using a

1. ruler
2. vernier caliper
3. micrometer and vernier caliper

calculate the density = mass/volume
calculate the uncertainty = sum of the percent uncertainty of each measuremetn
calculate the % deviation from accepted value for the density
hand in a sheet with raw data and calculations